

## CAP 6617 Sparse Learning

**Credits:** 3 credits

**Textbook, title, author, and year:** *None*

**Reference materials:** Sparse and Redundant Representations from Theory to Applications in Signal and Image Processing, Michael Elad, Springer 2010.  
Also research papers and notes.

### Specific course information

**Catalog description:** This course teaches students basic concepts of sparse learning, with applications in computer science, engineering, business and other areas. The class will cover major topics including math preliminaries, with new concepts, theory, algorithms, and applications of sparse representation and modeling and its relationship with deep learning. The topics covered include mathematical preliminaries, L1 optimization, pursuit algorithms, sparse dictionary learning, sparse deep learning, and applications in different fields.

**Prerequisites:** Linear Algebra and Engineering Graduate Standing

**Specific goals for the course:** The goal of this class is for students to gain theoretical foundation and hands-on experiences on sparse learning. At the end of the class, students should be able to understand the fundamentals of sparse dictionary learning and sparse deep learning, algorithmic and implementation details and should be able to apply sparse models to their research problems.

### Brief list of topics to be covered:

#### Topics

- Introduction
- Mathematical Preliminaries
- Basics of Sparse Representation
- L0 and L1 Optimization
- Optimization Algorithms
- Unsupervised Dictionary Learning
- Supervised Dictionary Learning
- From Sparse Learning to Deep Learning
- Sparse Deep Learning
- Case Studies